CLAIMS

1. A magnetic read head comprising:

a dual spin valve sensor including:

first and second pinned layer structures wherein each pinned layer structure has a magnetic moment;

antiferromagnetic first and second pinning layers exchange coupled to the first and second pinned layer structures respectively for pinning the magnetic moments of the first and second pinned layers respectively;

an antiparallel (AP) coupled free layer structure located between the first and second pinned layer structures and having a net magnetic moment; and

a nonmagnetic conductive first spacer layer located between the first pinned layer structure and the AP coupled free layer structure and a nonmagnetic conductive second spacer layer located between the second pinned layer structure and the AP coupled free layer structure;

the AP coupled free layer structure including:

ferromagnetic first, second and third antiparallel (AP) coupled free layers; and

a nonmagnetic first antiparallel (AP) coupling layer located between the first and second AP coupled free layers and a nonmagnetic second antiparallel (AP) coupling layer located between the second and third AP coupled free layers.

2. A magnetic read head as claimed in claim 1 comprising:

ferromagnetic first and second shield layers;

nonmagnetic nonconductive first and second read gap layers located between the first and second shield layers; and

the dual spin valve sensor being located between the first and second read gap layers.

3. A magnetic read head as claimed in claim 2 wherein the second AP coupled free layer has a magnetic thickness that is greater than a net magnetic thickness of the first and third AP coupled free layers.

4. A magnetic read head as claimed in claim 2 wherein the magnetic thicknesses of the first and third AP coupled free layers are equal.

5. A magnetic read head as claimed in claim 2 wherein the materials of the first and second pinning layers are the same.

6. A magnetic read head as claimed in claim 2 wherein the first and third AP coupled free layers are cobalt based and the second AP coupled free layer is nickel iron based.

7. A magnetic read head as claimed in claim 6 wherein the second AP coupled free layer has a magnetic thickness that is greater than a net magnetic thickness of the first and third AP coupled free layers.

8. A magnetic read head as claimed in claim 7 wherein the magnetic thicknesses of the first and third AP coupled free layers are equal.

9. A magnetic read head as claimed in claim 8 wherein the materials of the first and second pinning layers are the same.

10. A magnetic read head as claimed in claim 9 wherein the first pinned layer structure is a double antiparallel (AP) coupled pinned layer structure that includes:

ferromagnetic first and second antiparallel (AP) coupled pinned layers; and

a nonmagnetic antiparallel (AP) coupling layer located between and interfacing the first and second AP coupled pinned layers.

11. A magnetic read head as claimed in claim 10 wherein the second pinned layer structure is a triple antiparallel (AP) pinned layer structure that includes:

ferromagnetic first, second and third antiparallel (AP) coupled pinned layers; and

a nonmagnetic first antiparallel (AP) coupling layer located between and interfacing the first and second AP coupled pinned layers and a nonmagnetic second antiparallel (AP) coupling layer located between and interfacing the second and third AP coupled pinned layers.

12. A magnetic read head as claimed in claim 11 wherein the double AP pinned layer structure has a net magnetic moment that is equal to a net magnetic moment of the triple AP pinned layer structure.

13. A magnetic read head as claimed in claim 12 wherein:

each of the double and the triple AP pinned layer structures has a ferromagnetic coupling field with respect to the free layer structure; and

the ferromagnetic coupling fields of the double and the triple AP pinned layer structures are equal.

14. A magnetic head assembly comprising:

a write head including:

ferromagnetic first and second pole piece layers;

each of the first and second pole piece layers having a yoke portion located between a pole tip portion and a back gap portion;

a nonmagnetic write gap layer located between the pole tip portions of the first and second pole piece layers;

an insulation stack with at least one coil layer embedded therein located between the yoke portions of the first and second pole piece layers; and

the first and second pole piece layers being connected at their back gap portions; and

a read head including:

a dual spin valve sensor;

nonmagnetic nonconductive first and second read gap layers;

the dual spin valve sensor being located between the first and second read gap layers;

a ferromagnetic first shield layer; and

the first and second read gap layers being located between the first shield layer and the first pole piece layer; and

the dual spin valve sensor including:

first and second pinned layer structures wherein each pinned layer structure has a magnetic moment;

antiferromagnetic first and second pinning layers exchange coupled to the first and second pinned layer structures respectively for pinning the magnetic moments of the first and second pinned layers respectively;

an antiparallel (AP) coupled free layer structure located between the first and second pinned layer structures and having a net magnetic moment;

a nonmagnetic conductive first spacer layer located between the first pinned layer structure and the AP coupled free layer structure and a nonmagnetic conductive second spacer layer located between the second pinned layer structure and the AP coupled free layer structure;

the AP coupled free layer structure including:

ferromagnetic first, second and third antiparallel (AP) coupled free layers;

a nonmagnetic first antiparallel (AP) coupling layer located between the first and second AP coupled free layers and a nonmagnetic second antiparallel (AP) coupling layer located between the second and third AP coupled free layers.

15. A magnetic head assembly as claimed in claim 14 including:

the read head further including:

a ferromagnetic second shield layer;

a nonmagnetic separation layer; and

the separation layer being located between the second shield layer the first pole piece layer.

16. A magnetic head assembly as claimed in claim 14 wherein the first and third AP coupled free layers are cobalt based and the second AP coupled free layer is nickel iron based.

17. A magnetic head assembly as claimed in claim 16 wherein the second AP coupled free layer has a magnetic thickness that is greater than a net magnetic thickness of the first and third AP coupled free layers.

18. A magnetic head assembly as claimed in claim 17 wherein the magnetic thicknesses of the first and third AP coupled free layers are equal.

19. A magnetic head assembly as claimed in claim 18 wherein the materials of the first and second pinning layers are the same.

20. A magnetic head assembly as claimed in claim 19 wherein the first pinned layer structure is a double antiparallel (AP) coupled pinned layer structure that includes:

ferromagnetic first and second antiparallel (AP) coupled pinned layers; and

a nonmagnetic antiparallel (AP) coupling layer located between and interfacing the first and second AP coupled pinned layers.

21. A magnetic head assembly as claimed in claim 20 wherein the second pinned layer structure is a triple antiparallel (AP) pinned layer structure that includes:

ferromagnetic first, second and third antiparallel (AP) coupled pinned layers; and

a nonmagnetic first antiparallel (AP) coupling layer located between and interfacing the first and second AP coupled pinned layers and a nonmagnetic second antiparallel (AP) coupling layer located between and interfacing the second and third AP coupled pinned layers.

22. A magnetic head assembly as claimed in claim 21 wherein the double AP pinned layer structure has a net magnetic moment that is equal to a net magnetic moment of the triple AP pinned layer structure.

23. A magnetic head assembly as claimed in claim 22 wherein:

each of the double and the triple AP pinned layer structures has a ferromagnetic coupling field with respect to the free layer structure; and

the ferromagnetic coupling fields of the double and the triple AP pinned layer structures are equal.

24. A magnetic disk drive having at least one slider that has an air bearing surface (ABS), the slider supporting at least one magnetic head assembly that includes a read head and a write head, the disk drive comprising:

the write head including:

ferromagnetic first and second pole piece layers;

each of the first and second pole piece layers having a yoke portion located between a pole tip portion and a back gap portion;

a nonmagnetic write gap layer located between the pole tip portions of the first and second pole piece layers;

an insulation stack with at least one coil layer embedded therein located between the yoke portions of the first and second pole piece layers; and

the first and second pole piece layers being connected at their back gap portions; and

the read head including:

a dual spin valve sensor;

nonmagnetic nonconductive first and second read gap layers;

the dual spin valve sensor being located between the first and second read gap layers;

a ferromagnetic first shield layer; and

the first and second read gap layers being located between the first shield layer and the first pole piece layer;

the dual spin valve sensor including:

first and second pinned layer structures wherein each pinned layer structure has a magnetic moment;

antiferromagnetic first and second pinning layers exchange coupled to the first and second pinned layer structures respectively for pinning the magnetic moments of the first and second pinned layers respectively;

an antiparallel (AP) coupled free layer structure located between the first and second pinned layer structures and having a net magnetic moment; and

a nonmagnetic conductive first spacer layer located between the first pinned layer structure and the AP coupled free layer structure and a nonmagnetic conductive second spacer layer located between the second pinned layer structure and the AP coupled free layer structure;

the AP coupled free layer structure including:

ferromagnetic first, second and third antiparallel (AP) coupled free layers; and

a nonmagnetic first antiparallel (AP) coupling layer located between the first and second AP coupled free layers and a nonmagnetic second antiparallel (AP) coupling layer located between the second and third AP free layers;

a housing;

a magnetic disk rotatably supported in the housing;

a support mounted in the housing for supporting the magnetic head assembly with its ABS facing the magnetic disk so that the magnetic head assembly is in a transducing relationship with the magnetic disk;

a spindle motor for rotating the magnetic disk;

an actuator connected to the support for moving the magnetic head assembly to multiple positions with respect to said magnetic disk; and

a processor connected to the magnetic head assembly, to the spindle motor and to the actuator for exchanging signals with the magnetic head assembly, for controlling rotation of the magnetic disk and for controlling the position of the magnetic head assembly relative to the magnetic disk.

25. A magnetic disk drive as claimed in claim 24 including:

the read head further including:

a ferromagnetic second shield layer;

a nonmagnetic separation layer; and

the separation layer being located between the second shield layer the first pole piece layer.

26. A magnetic disk drive as claimed in claim 24 wherein the first and third AP coupled free layers are cobalt based and the second AP coupled free layer is nickel iron based.

27. A magnetic disk drive as claimed in claim 26 wherein the second AP coupled free layer has a magnetic thickness that is greater than a net magnetic thickness of the first and third AP coupled free layers.

28. A magnetic disk drive as claimed in claim 27 wherein the magnetic thicknesses of the first and third AP coupled free layers are equal.

29. A magnetic disk drive as claimed in claim 28 wherein the materials of the first and second pinning layers are the same.

30. A magnetic disk drive as claimed in claim 29 wherein the first pinned layer structure is a double antiparallel (AP) coupled pinned layer structure that includes:

ferromagnetic first and second antiparallel (AP) coupled pinned layers; and

a nonmagnetic antiparallel (AP) coupling layer located between and interfacing the first and second AP coupled pinned layers.

31. A magnetic disk drive as claimed in claim 30 wherein the second pinned layer structure is a triple antiparallel (AP) pinned layer structure that includes:

ferromagnetic first, second and third antiparallel (AP) coupled pinned layers; and

a nonmagnetic first antiparallel (AP) coupling layer located between and interfacing the first and second AP coupled pinned layers and a nonmagnetic second antiparallel (AP) coupling layer located between and interfacing the second and third AP coupled pinned layers.

32. A magnetic disk drive as claimed in claim 31 wherein the double AP pinned layer structure has a net magnetic moment that is equal to a net magnetic moment of the triple AP pinned layer structure.

33. A magnetic disk drive as claimed in claim 32 wherein:

each of the double and the triple AP pinned layer structures has a ferromagnetic coupling field with respect to the free layer structure; and

the ferromagnetic coupling fields of the double and the triple AP pinned layer structures are equal.

34. A method of making a read head comprising the steps of:

making a dual spin valve sensor comprising the steps of:

forming first and second pinned layer structures wherein each pinned layer structure has a magnetic moment;

forming antiferromagnetic first and second pinning layers exchange coupled to the first and second pinned layer structures for pinning the magnetic moment of the first and second pinned layers respectively;

forming an antiparallel (AP) coupled free layer structure between the first and second pinned layer structures with a magnetic moment; and

forming a nonmagnetic conductive first spacer layer between the first pinned layer structure and the AP coupled free layer structure and a nonmagnetic conductive second spacer layer between the second pinned layer structure and the AP coupled free layer structure;

a making of the AP coupled free layer structure including the steps of:

forming ferromagnetic first, second and third antiparallel (AP) coupled free layers; and

forming a nonmagnetic first antiparallel (AP) coupling layer between the first and second AP coupled free layers and a nonmagnetic second antiparallel (AP) coupling layer between the second and third AP free layers.

35. A method as claimed in claim 34 comprising:

forming ferromagnetic first and second shield layers;

forming nonmagnetic nonconductive first and second read gap layers between the first and second shield layers; and

forming the dual spin valve sensor being between the first and second read gap layers.

36. A method as claimed in claim 31 wherein the first and third AP coupled free layers are formed of a cobalt based material and the second AP coupled free layer is formed of a nickel iron based material.

37. A method as claimed in claim 36 wherein the second AP coupled free layer is formed with a magnetic thickness that is greater than a net magnetic thickness of the first and third AP coupled free layers.

38. A method as claimed in claim 37 wherein the magnetic thicknesses of the first and third AP coupled free layers are equal.

39. A method as claimed in claim 38 wherein the materials of the first and second pinning layers are the same.

40. A method as claimed in claim 39 wherein the first pinned layer structure is a double antiparallel (AP) pinned layer structure that is formed comprising the steps of:

forming ferromagnetic first and second antiparallel (AP) coupled pinned layers; and

forming an antiparallel (AP) coupling layer between and interfacing the first and second AP pinned layers.

41. A method as claimed in claim 40 wherein the second pinned layer is a triple antiparallel (AP) pinned layer structure that is made comprising the steps of:

forming ferromagnetic first, second and third antiparallel (AP) coupled pinned layers; and

forming a nonmagnetic first antiparallel (AP) coupling layer between and interfacing the first and second AP pinned layers and forming a nonmagnetic second antiparallel (AP) coupling layer between and interfacing the second and third AP pinned layers.

42. A method as claimed in claim 41 wherein the double AP pinned layer structure is formed with a net magnetic moment that is equal to a net magnetic moment of the triple AP pinned layer structure.

43. A method as claimed in claim 42 wherein:

each of the double and the triple AP pinned layer structures is formed with a ferromagnetic coupling field with respect to the free layer structure; and

the ferromagnetic coupling fields of the double and the triple AP pinned layer structures are equal.

44. A method of making a magnetic head assembly having a read head and a write head comprising the steps of:

a forming of the write head comprising the steps of:

forming ferromagnetic first and second pole piece layers with a yoke portion between a pole tip portion and a back gap portion;

forming a nonmagnetic write gap layer between the pole tip portions of the first and second pole piece layers;

forming an insulation stack with at least one coil layer embedded therein in the yoke portions of the first and second pole piece layers; and

connecting the first and second pole piece layers at their back gaps portions;

a forming of the read head comprising the steps of:

forming nonmagnetic nonconductive first and second read gap layers;

forming a dual spin valve sensor between the first and second read gap layers;

forming a ferromagnetic first shield layer; and

forming the first and second read gap layers between the first shield layer and the first pole piece layer;

a making of the dual spin valve sensor comprising the steps of:

forming first and second pinned layer structures wherein each pinned layer structure has a magnetic moment;

forming antiferromagnetic first and second pinning layers exchange coupled to the first and second pinned layer structures for pinning the magnetic moment of the first and second pinned layers respectively;

forming an antiparallel (AP) coupled free layer structure between the first and second pinned layer structures with a magnetic moment; and

forming a nonmagnetic conductive first spacer layer between the first pinned layer structure and the AP coupled free layer structure and a nonmagnetic conductive second spacer layer between the second pinned layer structure and the AP coupled free layer structure; and

a making of the AP coupled free layer structure including the steps of:

forming ferromagnetic first, second and third antiparallel (AP) coupled free layers; and

forming a first antiparallel (AP) coupling layer between the first and second AP coupled free layers and a second antiparallel (AP) coupling layer between the second and third AP free layers.

45. A method as claimed in claim 44 further comprising the steps of:

forming a ferromagnetic second shield layer between the second read gap layer and the first pole piece layer; and

forming a nonmagnetic separation layer between the second shield layer the first pole piece layer.

46. A method as claimed in claim 44 as claimed in claim wherein the first and third AP coupled free layers are formed of a cobalt based material and the second AP coupled free layer is formed of a nickel iron based material.

47. A method as claimed in claim 46 wherein the second AP coupled free layer is formed with a magnetic thickness that is greater than a net magnetic thickness of the first and third AP coupled free layers.

48. A method as claimed in claim 47 wherein the magnetic thicknesses of the first and third AP coupled free layers are equal.

49. A method as claimed in claim 48 wherein the materials of the first and second pinning layers are the same.

50. A method as claimed in claim 49 wherein the first pinned layer structure is a double antiparallel (AP) pinned layer structure that is formed comprising the steps of:

forming ferromagnetic first and second antiparallel (AP) coupled pinned layers; and

forming an antiparallel (AP) coupling layer between and interfacing the first and second AP pinned layers.

51. A method as claimed in claim 50 wherein the second pinned layer is a triple antiparallel (AP) pinned layer structure that is made comprising the steps of:

forming ferromagnetic first, second and third antiparallel (AP) coupled pinned layers; and

forming a nonmagnetic first antiparallel (AP) coupling layer between and interfacing the first and second AP pinned layers and forming a nonmagnetic second antiparallel (AP) coupling layer between and interfacing the second and third AP pinned layers.

52. A method as claimed in claim 51 wherein the double AP pinned layer structure is formed with a net magnetic moment that is equal to a net magnetic moment of the triple AP pinned layer structure.

53. A method as claimed in claim 52 wherein:

each of the double and the triple AP pinned layer structures is formed with a ferromagnetic coupling field with respect to the free layer structure; and

the ferromagnetic coupling fields of the double and the triple AP pinned layer structures are equal.